CLAIMS

1. A composite antenna device comprising:

a ground board;

an unbalanced antenna including

a first feeding point coupled with the ground board,

a first radiator having a first end and a second end, the first end of the first radiator being connected with the first feeding point,

a load conductor connected with the second end of the first radiator; and

a balanced antenna including

a second feeding point,

a second radiator connected with the second feeding point, and

a third radiator connected with the second feeding point,

wherein the load conductor has a shape symmetrical about a straight line which passes through the first feeding point and which is perpendicular to the ground board, and

wherein the second radiator and the third radiator are placed at positions symmetrical to each other about the straight line, respectively, and have shapes symmetrical to each other about the straight line.

2. A composite antenna device comprising:

a ground board;

an unbalanced antenna including

a first feeding point coupled with the ground board,

a first radiator having a first end and a second end, the

first end of the first radiator being connected with the first feeding point, and

a load conductor connected with the second end of the first radiator;

a balanced antenna including

a second feeding point,

a second radiator connected with the second feeding point, and

a third radiator connected with the second feeding point,

wherein the load conductor has a shape electrically symmetrical about a straight line, the straight line passing through the first feeding point and being perpendicular to the ground board, and

wherein the second radiator and the third radiator are placed at positions electrically symmetrical to each other about the straight line, respectively, and have shapes electrically symmetrical to each other about the straight line.

3. A composite antenna device comprising:

a ground board;

an unbalanced antenna including

a first feeding point coupled with the ground board,

a first radiator having a first end and a second end, the first end of the first radiator being connected with the first feeding point, and

a load conductor connected with the second end of the first radiator;

a balanced antenna including

a second feeding point,

a second radiator connected with the second feeding point, and

a third radiator connected with the second feeding point,

wherein the load conductor has a shape symmetrical about a plane, the plane passing through the first feeding point and being perpendicular to the ground board, and

wherein the second radiator and the third radiator are placed at positions symmetrical positions each other about the plane, respectively, and have shapes symmetrical to each other about the plane.

4. A composite antenna device comprising:

a ground board;

an unbalanced antenna including

a first feeding point coupled with the ground board,

a first radiator having a first end and a second end, the first end of the first radiator being connected with the first feeding point, and

a load conductor connected with the second end of the first radiator;

a balanced antenna including

a second feeding point,

a second radiator connected with the second feeding point, and

a third radiator connected with the second feeding point,

wherein the load conductor has a shape electrically symmetrical about a plane, the plane passing through the first feeding point and being

perpendicular to the ground board, and

wherein the second radiator and the third radiator are placed at positions electrically symmetrical to each other about the plane, respectively, and have shapes electrically symmetrical to each other about the plane.

5. A composite antenna device comprising:

a ground board;

an unbalanced antenna including

a first feeding point coupled with the ground board,

a first radiator having a first end and a second end, the first end of the first radiator being connected with the first feeding point, and

a load conductor having a connection point where the load conductor is connected with the second end of the first radiator;

a balanced antenna including

a second feeding point,

a second radiator connected with the second feeding point, and

a third radiator connected with the second feeding point,

wherein the load conductor of the unbalanced antenna includes a first portion and a second portion, the first portion of the load conductor being provided between the first end of the load conductor and the connection point, the second portion being provided between the second end of the load conductor and the connection point, and

wherein an impedance Z11 of the first portion of the load conductor, a mutual impedance Z12 of the second radiator to the first portion of the load conductor, a mutual impedance Z21 of the first portion of the load

conductor to the second radiator, an impedance Z22 of the second radiator, an impedance Z33 of the second portion of the load conductor, a mutual impedance Z34 of the third radiator to the second portion of the load conductor, a mutual impedance Z43 of the second portion of the load conductor to the third radiator, and an impedance Z44 of the third radiator satisfy the relation of

$$\begin{pmatrix} Z11 & Z12 \\ Z21 & Z22 \end{pmatrix} = \begin{pmatrix} Z33 & Z34 \\ Z43 & Z44 \end{pmatrix}.$$

6. The composite antenna device of claim 5, wherein a mutual impedance Z14 of the third radiator to the first portion of the load conductor, a mutual impedance Z41 of the first portion of the load conductor to the third radiator, a mutual impedance Z23 of the second portion of the load conductor to the second radiator, and a mutual impedance Z32 of the second radiator to the second portion of the load conductor satisfy the relation of

$$\begin{pmatrix} Z11 & Z14 \\ Z43 & Z44 \end{pmatrix} = \begin{pmatrix} Z22 & Z23 \\ Z32 & Z33 \end{pmatrix}.$$